
Test Procedure for**TESTING EPOXY MATERIALS****TxDOT Designation: Tex-614-J****Effective Date: January 2008**

1. SCOPE

- 1.1 This test method covers various test procedures for epoxy materials specified in DMS-6100. The tests performed depend upon the requirements set forth for each particular material.
- 1.2 This test method includes the following test procedures:
- compressive strength
 - viscosity of mixed components
 - difference in viscosity
 - stability
 - gel time
 - tensile bond
 - tensile bond for Type I epoxy
 - thixotropy
 - tensile shear strength
 - impact strength
 - wet strength
 - wet pullout strength
 - grind
 - bond strength of fresh concrete to cured concrete
 - old concrete to new grout mix
 - hiding power
 - water gain
 - contact time.
- 1.3 The values given in parentheses (if provided) are not standard and may not be exact mathematical conversions. Use each system of units separately. Combining values from the two systems may result in nonconformance with the standard.

2. COMPONENT RATIOS

- 2.1 Determine the weight per gallon/liter of each component in accordance with ASTM D 1475. For all tests performed on the mixed epoxy, determine the proper weight ratio of resin and hardener components based on the weight per gallon/liter and the specified volume ratio.
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3. COMPRESSIVE STRENGTH

- 3.1 The following test applies to epoxy Types I and IV.
- 3.2 *Apparatus:*
- 3.2.1 *PVC tubing, 1 × 2 in. (25 × 50 mm) in length, for use as molds.*
- 3.2.2 *Machine lathe.*
- 3.2.3 *Mold release grease.*
- 3.2.4 *Plastic film and rubber bands, to seal bottoms of the molds.*
- 3.2.5 *Metal ointment can, 6 fl. oz. (170 mL).*
- 3.2.6 *Balance, Class G5 in accordance with Tex-901-K, minimum capacity of 2000 g.*
- 3.2.7 *Compression testing machine, as described in ASTM D 695, Section 5.1, capable of a constant rate of crosshead movement of 0.05 in./min. and capable of applying a maximum load of at least 10,000 lbf. Use compression plates that are flat and parallel to each other in a plane normal to the vertical loading axis.*
- 3.3 *Procedure:*
- 3.3.1 Set up 3 of the PVC molds for each test sample. Coat the inside of the molds with release grease. Seal the bottom of the molds with a plastic film to prevent leakage.
Note 1—For Type I epoxy, set up 2 sets of 3 molds.
- 3.3.2 Use the component ratios to determine the amount of each component necessary to make 200 g of mixed epoxy. Weigh the components into a metal can. Mix components for 3 min. Fill the molds with the epoxy.
- 3.3.3 Condition the epoxy specimens. For Type I epoxy, allow specimens to cure at the temperature specified. Cure 1 set of specimens for 24 hr. and the second set for 48 hr. For Type IV epoxy, allow the specimens to cure for 48 hr. at 77°F (25°C).
- 3.3.4 Compress specimens in a compression-testing machine. Test specimen at a rate of 0.05 in. (1.3 mm) per min. Record the load at failure or at 0.1 in. (2.5 mm) crosshead travel, whichever occurs first.
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- 3.3.5 Calculate the compressive strength. Use the calculations listed under Section 3.4. Average the results from all the specimens. Report results in psi (kPa).

3.4 *Calculations:*

- 3.4.1 Calculate compressive strength:

$$(C_s = L / \pi r^2, \text{psi})$$

Where:

C_s = compressive strength, psi (kPa)

L = load, lb. (N)

r = radius of the specimen, in. (m).

4. VISCOSITY OF MIXED COMPONENTS

- 4.1 Use the following method to determine the mixed viscosity of epoxy Types III, IV, V, VII, and IX.

4.2 *Apparatus:*

- 4.2.1 *Brookfield viscometer.*

- 4.2.2 *Friction top cans, 1 pt. (500 mL) and 1 qt. (1 L).*

- 4.2.3 *Thermometer, range 66–80°F (19–27°C), 0.2 division (F17 thermometer as shown in ASTM E 1).*

- 4.2.4 *Spatula.*

- 4.2.5 *Balance, Class G5 in accordance with Tex-901-K, minimum capacity of 2000 g.*

- 4.2.6 *Stopwatch.*

4.3 *Procedure:*

- 4.3.1 Set up the viscometer according to manufacturer's instructions. Level the instrument. Set the speed control at 20 rpm, or set the speed control at 10 rpm if the viscosity of the material is greater than 1200 poise. Choose the proper spindle for the viscosity measurement and attach the spindle to the viscometer.

Note 2—Type of spindle depends on measured viscosity range and type of viscometer.

- 4.3.2 Measure the temperature of each component of epoxy and ensure the temperature of each is $77 \pm 2^\circ\text{F}$ ($25 \pm 1^\circ\text{C}$). Using the mixing ratios, determine the amount of resin and hardener needed to make 400 g of mixed epoxy. Weigh components into a 1-pt. (500-mL) can. Mix the epoxy for 3 min.

- 4.3.3 Adjust the height of the viscometer to bring the liquid level to the indentation in the spindle. Ensure that there is at least a 1-in. (25-mm) clearance between the bottom and sides of the spindle and the container when immersing the spindle to the proper depth in the sample. Immerse the spindle into the epoxy.

Note 3—With disk-type spindles, first immerse the spindle in the liquid at an angle to eliminate air bubbles, and then attach the spindle to the shaft.

- 4.3.4 Start the viscometer. Allow the reading to stabilize. Measure and record the viscosity.

5. DIFFERENCE IN VISCOSITY

- 5.1 Use the following method to determine the difference in viscosity between the 2 components of a Type II epoxy.

5.2 *Apparatus:*

- 5.2.1 *Brookfield viscometer.*

- 5.2.2 *Friction top cans, 1 pt. (500 mL).*

- 5.2.3 *Thermometer, range 66–80°F (19–27°C), 0.2 division (F17 thermometer as shown in ASTM E 1).*

- 5.2.4 *Spatula.*

- 5.2.5 *Balance, Class G5 in accordance with Tex-901-K, minimum capacity of 2000 g.*

- 5.2.6 *Stopwatch.*

5.3 *Procedure:*

- 5.3.1 Set up the viscometer according to manufacturer's instructions. Level the instrument. Set the speed control at 20 rpm, or set the speed control at 10 rpm if the viscosity of the material is greater than 1200 poise. Choose the proper spindle for the viscosity measurement and attach the spindle to the viscometer.

Note 4—Type of spindle depends on measured viscosity range and type of viscometer.

- 5.3.2 Measure the temperature of each component of the epoxy and ensure the temperature of each is $77 \pm 2^\circ\text{F}$ ($25 \pm 1^\circ\text{C}$). Place 400 g of each component into separate 1-pt. (500-mL) cans.

- 5.3.3 Adjust the height of the viscometer to bring the liquid level to the indentation in the spindle. Ensure that there is at least a 1-in. (25-mm) clearance between the bottom and sides of the spindle and the container when immersing the spindle to the proper depth in the sample. Immerse the spindle into one of the components.

- 5.3.4 Start the viscometer. Allow the reading to stabilize. Measure and record the viscosity.

5.3.5 Stop the viscometer. Clean the spindle. Repeat the procedure beginning at Section 5.3.2 for the second component.

5.3.6 Use the two measurements to calculate and report the difference in viscosity.

5.4 *Calculations:*

5.4.1 Calculate the difference in viscosity:

$$\text{Difference in viscosity} = \frac{v_2 - v_1}{v_1} (100)$$

Where:

v_1 = lower viscosity reading

v_2 = higher viscosity reading.

6. STABILITY

6.1 The stability test applies to epoxy Types II, V, VII, and VIII. For the stability on Type II epoxy, measure the viscosity of the individual components. For the stability on Types V, VII, and VIII epoxies, measure the viscosity on the mixed epoxy.

6.2 *Apparatus:*

6.2.1 *Brookfield viscometer.*

6.2.2 *Friction top cans, 1 pt. (500 mL) and 1 qt. (1 L).*

6.2.3 *Thermometer, range 66–80°F (19–27°C), 0.2 division (F17 thermometer as shown in ASTM E 1).*

6.2.4 *Oven, capable of maintaining a temperature of 120°F (49°C).*

6.2.5 *Metal spatula.*

6.2.6 *Balance, Class G5 in accordance with Tex-901-K, minimum capacity of 2000 g.*

6.2.7 *Stopwatch.*

6.3 *Procedure:*

6.3.1 Fill separate 1-qt. (1-L) cans with resin and hardener. Place the resin and hardener in the oven, set at 120°F (49°C), for 14 days.

6.3.2 Remove epoxy from oven and allow the material to cool to $77 \pm 2^\circ\text{F}$ ($25 \pm 1^\circ\text{C}$).

6.3.3 Set up the viscometer according to manufacturer's instructions. Level the instrument. Set the speed control at 20 rpm, or set the speed control at 10 rpm, if the viscosity of the

material is greater than 1200 poise. Choose the proper spindle for the viscosity measurement and attach the spindle to the viscometer.

Note 5—Type of spindle depends on measured viscosity range and type of viscometer.

6.3.4 Measure the temperature of each component of the epoxy, and ensure the temperature of each is $77 \pm 2^\circ\text{F}$ ($25 \pm 1^\circ\text{C}$).

- For Type II epoxy, place 400 g of each component into separate 1-pt. (500-mL) cans.
- For Types V, VII, and VIII epoxy, use the mixing ratios and measure 400 g of resin and hardener into a 1-pt. (500-mL) can. Then mix the epoxy for 3 min.

6.3.5 Adjust the height of the viscometer to bring the liquid level to the indentation in the spindle. Ensure that there is at least a 1-in. (25-mm) clearance between the bottom and sides of the spindle and the container when immersing the spindle to the proper depth in the sample. Immerse the spindle into the epoxy.

Note 6—With disk type spindles, first immerse the spindle in the liquid at an angle to eliminate air bubbles, and then attach the spindle to the shaft.

6.3.6 Start the viscometer. Allow the reading to stabilize. Measure and record the viscosity.

- For Type II epoxy, repeat Sections 6.3.4 and 6.3.5 for the second component

6.3.7 Use the stability calculation to determine the stability.

- For Type II epoxy, use the viscosities determined from the difference in viscosity test as the viscosity of original material.
- For Types V, VII, and VIII epoxy, use the viscosities determined from the viscosity of mixed components test as the viscosity of original material.

6.4 *Calculations:*

6.4.1 Calculate stability:

$$\text{Stability} = \frac{v_2 - v_1}{v_1} (100)$$

Where:

v_1 = viscosity of original material

v_2 = viscosity of aged material.

7. GEL TIME

7.1 *Gel Time for All Epoxy Types, (Except Type X):*

7.1.1 *Apparatus:*

7.1.1.1 *Thermometer, range 66–80°F (19–27°C) (F17 thermometer as shown in ASTM E 1).*

- 7.1.1.2 *Balance*, Class G5 in accordance with Tex-901-K, minimum capacity of 2000 g.
- 7.1.1.3 *Metal ointment can*, 6 fl. oz. (170 mL).
- 7.1.1.4 *Metal spatula*.
- 7.1.1.5 *Wooden block*, minimum thickness of 1 in. (25 mm).
- 7.1.1.6 *Toothpick*, round, wooden.
- 7.1.1.7 *Stopwatch*.
- 7.1.2 *Procedure:*
- 7.1.2.1 Measure the temperature of each component of the epoxy and ensure the temperature of each is $77 \pm 2^{\circ}\text{F}$ ($25 \pm 1^{\circ}\text{C}$). Using the component ratios, determine the amount of each component necessary to make a total 100 g of mixed adhesive.
Note 7—Condition the Type I epoxy to the specified temperature.
- 7.1.2.2 Weigh 100 g total of adhesive into a 6-fl. oz. (170-mL) metal ointment can.
- 7.1.2.3 Start the stopwatch and mix the 2 components for 3 min. with a spatula. During the mixing, scrape the sides and bottom of the can periodically.
Note 8—For adhesives that gel in less than 3 min., mix the components for 1 min.
- 7.1.2.4 After mixing, place the can with the mixed adhesive on a wooden block. Insert toothpick in the center of mixed material.
- 7.1.2.5 Probe the material to determine the gel time.
- If adhesive has a gel time less than 20 min., probe adhesive every minute until it gels.
 - If adhesive has a gel time above 20 min., probe the mixed adhesive every minute starting 16 min. from the initiation of mixing until center of material gels.
- Note 9**—An adhesive reaches its gel point when a ball of cured material forms in the center.
- 7.1.2.6 Record the elapsed time as the gel time.
- 7.2 *Gel Time for Epoxy Type X:*
- 7.2.1 *Apparatus:*
- 7.2.1.1 *Thermometer*, range 66–80°F (19–27°C) (F17 thermometer as shown in ASTM E 1).
- 7.2.1.2 *Balance*, Class G5 in accordance with Tex-901-K, minimum capacity of 2000 g.
- 7.2.1.3 *Friction top can*, 1 pt. (500 mL), with friction lip removed.
- 7.2.1.4 *Metal spatula*.

- 7.2.1.5 *Wooden block*, minimum thickness of 1 in. (25 mm).
- 7.2.1.6 *Glass stirring rod*.
- 7.2.1.7 *Stopwatch*.
- 7.2.2 *Procedure:*
- 7.2.2.1 Measure the temperature of each component of the epoxy and ensure the temperature of each is $77 \pm 2^{\circ}\text{F}$ ($25 \pm 1^{\circ}\text{C}$). Using the component ratios, determine the amount of each component necessary to make a total 300 g of mixed epoxy.
- 7.2.2.2 Weigh a total of 300 g of epoxy into a 1-pt. (500-mL) can.
- 7.2.2.3 Start the stopwatch and mix the two components for 5 min. with a spatula. During the mixing, scrape the sides and bottom of the can periodically.
- 7.2.2.4 After mixing, place the can on a wooden block. Allow mixed material to sit for 35 min.
- 7.2.2.5 To determine the gel time, probe mixed material every 5 min. with a glass stirring rod until it gels. Record the elapsed time as the gel time.
- Note 10**—An epoxy reaches its gel point when a ball of cured material forms in the center.
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8. TENSILE BOND

- 8.1 Use the following method to determine the tensile bond strength of epoxy Types II, III, V, VII, and VIII.
- 8.2 *Making Mortar Briquettes:*
- 8.2.1 *Apparatus:*
- 8.2.1.1 *Cement*, Type III.
- 8.2.1.2 *Washed river sand aggregate*, sieved though a No. 4 sieve.
- 8.2.1.3 *Molds*, of the type shown in Figure 1. Molds must be made of material not attacked by cement mortar. The molds must have sufficient dimensions to make briquettes of the size shown in Figure 2. The waistline of each briquette must be 1 ± 0.02 in. (25 ± 0.5 mm), and the thickness of the molds must be 1 ± 0.02 in. (25 ± 0.5 mm).

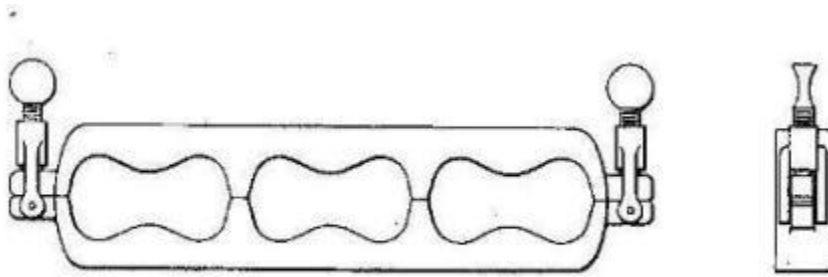


Figure 1—Briquette Mold

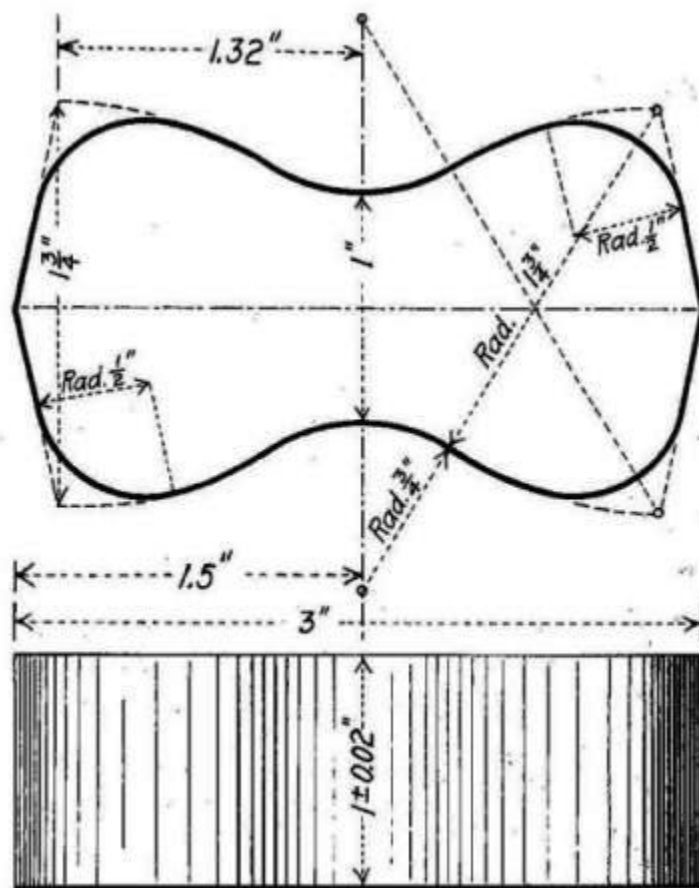


Figure 2—Required Briquette Specimen Dimensions

- 8.2.1.4 *Metal shims, 1 in. (25.4 mm) square, 0.037 ± 0.003 in. (0.94 ± 0.08 mm) thick.*
- 8.2.1.5 *Trowel, with a steel blade 4–6 in. (100–150 mm) in length with straight edges.*

- 8.2.1.6 *Rubber tamper*, with a cross section of $1/2 \times 1$ in. (13×25 mm) and a length of 5–6 in. (120–150 mm). The tamping face must be flat and at right angles to the length of the tamper.
- 8.2.1.7 *Moist cabinet or room*, conforming to the requirements of ASTM C 511.
- 8.2.1.8 *Water storage tank*, conforming to the requirements of ASTM C 511.
- 8.2.1.9 *Glass graduate*, with a capacity of at least 125 mL and capable of delivering 125 mL of water at 68°F (20°C) with a variation of ± 1.0 mL.
- 8.2.1.10 *Balance*, Class G5 in accordance with Tex-901-K, minimum capacity of 2000 g.
- 8.2.2 *Mortar Briquette Procedure:*
- 8.2.2.1 Place a shim vertically in the 1-in. waistline of each briquette mold. Coat the inside of the molds in release material. Set the mold on top of an ungreased sheet of glass.
- 8.2.2.2 Obtain components for making the cement mortar, which is 1 part cement to 3 parts aggregate:
- 750 g of river sand
 - 250 g of cement
 - 125 mL of water.
- 8.2.2.3 Thoroughly mix sand and cement. Create a crater in the center of the sand and cement mixture, and pour water into the center of the crater. Scoop the material from the sides into the crater over the top of the water within 30 sec. of adding the water. For the next 30 sec., trowel the dry mortar around the outside of the cone over the remaining mortar for the absorption of water. Complete the operation with vigorous mixing, squeezing, and kneading the mortar by hand for 1.5 min. During the mixing operation, protect hands with rubber gloves.
- 8.2.2.4 Fill the molds with concrete on both sides of the shim. Press the mortar firmly with the rubber tamper, applying a force of approximately 15–20 lbf. Tamp each briquette 12 times. Add more mortar and compact again until mold is complete. Heap more mortar above the mold and smooth it off with a trowel.
- 8.2.2.5 Place the mold with the briquettes in a moist cabinet and cure for 24 hr. After 24 hr., remove the briquettes from the mold and immerse them in the water storage tank for 6 days.
- 8.2.2.6 Remove the briquettes from the water storage tank, and allow the briquettes to dry before use.
- 8.3 *Tensile Bond Test:*
- 8.3.1 *Apparatus:*
- 8.3.1.1 *Metal spatula.*

- 8.3.1.2 *Metal ointment can*, 6 fl. oz. (170 mL).
- 8.3.1.3 *Oven*, capable of maintaining a temperature of 120°F (49°C).
- 8.3.1.4 *Balance*, Class G5 in accordance with Tex-901-K, minimum capacity of 2000 g.
- 8.3.1.5 *Testing machine*, capable of maintaining a constant rate of travel of 0.05 in./min. (1.3 mm/min.) and applying a tensile force of at least 500 lbf. (2.2 kN) Use grips to hold specimens as shown in Figure 3.

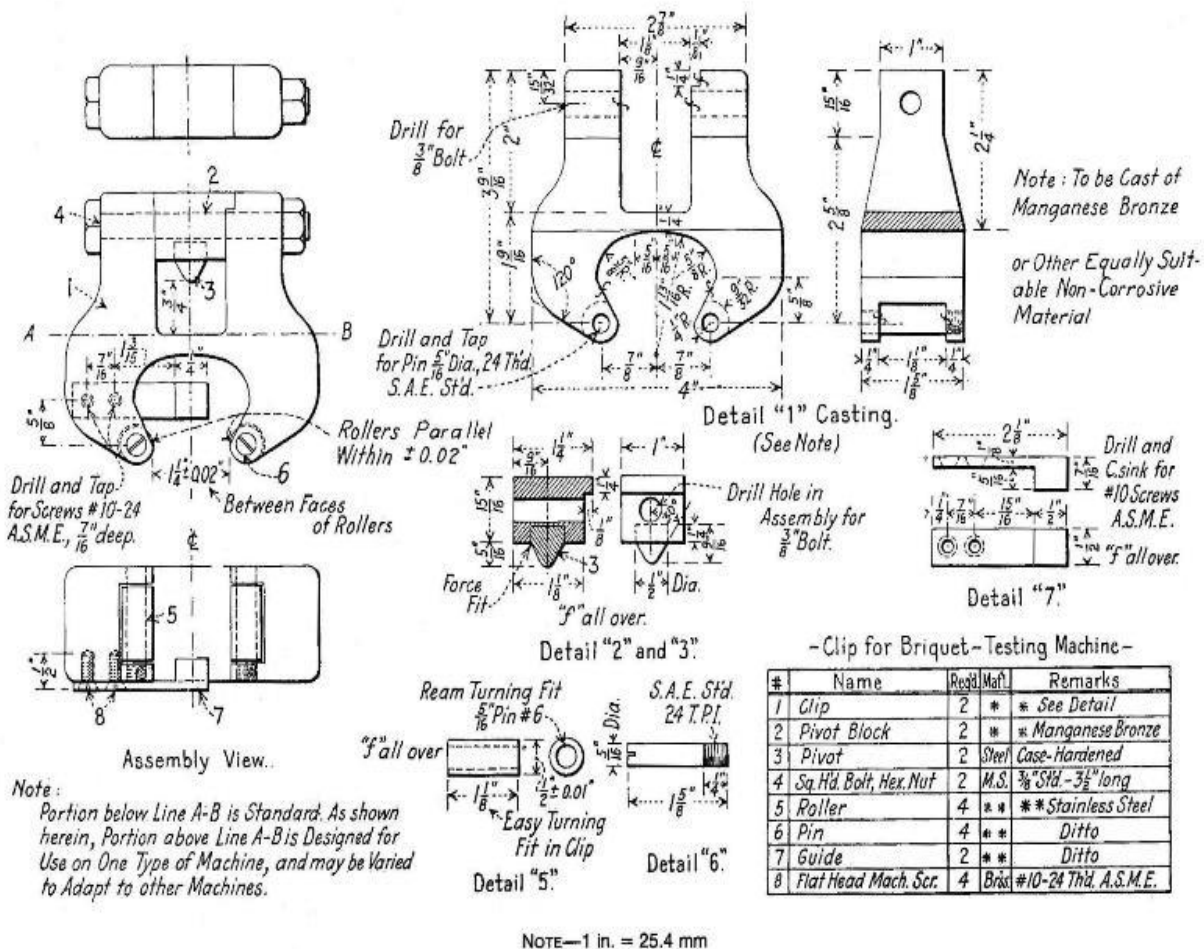


Figure 3—Grips for Constant Rate of Crosshead Movement Testing Machine

- 8.3.2 *Procedure:*
- 8.3.2.1 Divide the briquettes into sets of six. Sandblast the bonding face of each mortar briquette to remove the laitance on the surface. After sandblasting, clean the bonding faces of the briquettes with compressed air.
- Note 11**—Do not touch bonding faces after sandblasting.
- 8.3.2.2 Ensure that the initial temperature of each epoxy component is $77 \pm 2^\circ\text{F}$ ($25 \pm 1^\circ\text{C}$). Using the component ratios, determine the amount of each component necessary to make

a total 50 g of mixed epoxy. Weigh 50 g of total epoxy components into a metal ointment can. Mix with a spatula for 3 min.

- 8.3.2.3 Place a small amount of epoxy on the bonding face of each briquette. Use a spatula to spread the epoxy uniformly across the bonding face. Adhere the faces of 2 briquettes together with light pressure, and repeat for the remaining briquettes. Remove the excess epoxy from the edges of the bonded area with a spatula and stand upright.

- Make one set of three specimens for epoxy Types II, V, VII, and VIII.
- Make two sets of three specimens for epoxy Type III.

Note 12—Allow no more than 10 min. to elapse during preparation of the specimens. For Type II, allow no more than 6 min.

- 8.3.2.4 Condition the specimens using the parameters listed in Table 1.

Table 1—Conditioning Parameters for Tensile Bond Specimen

Epoxy Type	Parameters
Type II	Cure the specimens for 2 hr. at $77 \pm 2^\circ\text{F}$ ($25 \pm 1^\circ\text{C}$)
Type III	Cure one set of three specimens for 6 hr. at $77 \pm 2^\circ\text{F}$ ($25 \pm 1^\circ\text{C}$). Cure the second set for 48 hr. at $77 \pm 2^\circ\text{F}$ ($25 \pm 1^\circ\text{C}$), and then place the specimens in the oven for 1 hr. at $120 \pm 2^\circ\text{F}$ ($49 \pm 1^\circ\text{C}$)
Type V	Cure the specimens for 6 hr. at $77 \pm 2^\circ\text{F}$ ($25 \pm 1^\circ\text{C}$)
Type VII	Cure the specimens for 6 hr. at $77 \pm 2^\circ\text{F}$ ($25 \pm 1^\circ\text{C}$)
Type VIII Class A	Cure the specimens for 24 hr. at $77 \pm 2^\circ\text{F}$ ($25 \pm 1^\circ\text{C}$)
Type VIII Class B	Cure the specimens for 6 hr. at $77 \pm 2^\circ\text{F}$ ($25 \pm 1^\circ\text{C}$)

- 8.3.2.5 Start up tensile machine according to manufacturer's instructions. Balance and calibrate the tensile machine. Place the grips on the machine. Set the crosshead speed to 0.05 in./min. (1.3 mm/min.)
- 8.3.2.6 Load a briquette into the tensile machine. Start the testing machine and load until break. Record the load at break. Repeat test for the remaining specimen.
- For Type III set of specimen cured at 120°F (49°C), test each specimen, one at a time, immediately after removing it from the oven
- 8.3.2.7 Report the average load at break as the tensile bond strength.

9. TENSILE BOND FOR TYPE I EPOXY

9.1 Apparatus:

9.1.1 Metal spatula.

9.1.2 Metal ointment can, 6 fl. oz (170 mL).

- 9.1.3 *Balance*, Class G5 in accordance with Tex-901-K, minimum capacity of 2000 g.
- 9.1.4 *Third-point loading apparatus*, as described in ASTM C 78.
- 9.1.5 *Environmental chamber*, capable of maintaining temperatures of $60 \pm 2^\circ\text{F}$ ($16 \pm 1^\circ\text{C}$), $80 \pm 2^\circ\text{F}$ ($27 \pm 1^\circ\text{C}$), and $105 \pm 2^\circ\text{F}$ ($41 \pm 1^\circ\text{C}$).
- 9.2 *Procedure:*
- 9.2.1 Prepare and cure two flexural concrete specimens as described in ASTM C 78. Cut the cured concrete beams in half.
- 9.2.2 Ensure that the ambient temperature in the chamber and the initial temperature of each epoxy component is the temperature specified. Using the component ratios, determine the amount of each component necessary to make a total 100 g of mixed epoxy. Weigh 100 g of epoxy components into a metal ointment can. Mix with a spatula for 3 min.
- 9.2.3 Place a layer of epoxy on the bonding face of each block. The bonding face is the side opposite to the cut. Use a spatula to spread the epoxy uniformly across the bonding face. Adhere the faces of two halves together to make a complete block.
- 9.2.4 Allow the blocks to cure for 24 hr. at the specified temperature.
- 9.2.5 Test the blocks in the third-point loading apparatus. Report the average of the two blocks.

10. THIXOTROPY

- 10.1 Use the following tests to determine the thixotropy of epoxy Types I, II, III, and VIII.
- 10.2 *Thixotropy Test:*

Table 2—Thixotropy Test Parameters

Testing Parameter	Type I	Type II	Type III	Type VIII
Conditioning Temperature	Class A: $60 \pm 2^\circ\text{F}$ ($16 \pm 1^\circ\text{C}$) Class B: $80 \pm 2^\circ\text{F}$ ($27 \pm 1^\circ\text{C}$) Class C: $105 \pm 2^\circ\text{F}$ ($41 \pm 1^\circ\text{C}$)	$120 \pm 2^\circ\text{F}$ ($49 \pm 1^\circ\text{C}$)	$120 \pm 2^\circ\text{F}$ ($49 \pm 1^\circ\text{C}$)	$77 \pm 2^\circ\text{F}$ ($25 \pm 1^\circ\text{C}$)
Form Thickness	0.1 in. (2.5 mm)	0.1 in. (2.5 mm)	0.05 in. (1.3 mm)	0.25 in. (6.4 mm)
Measurement Type	Sag	Sag	Thickness Retained	Sag
Special Instructions	-	-	-	Test with epoxy and sand mixture

- 10.2.1 *Apparatus:*
- 10.2.1.1 *Forced draft oven*, capable of maintaining temperatures of $120 \pm 2^\circ\text{F}$ ($49 \pm 1^\circ\text{C}$).

- 10.2.1.2 *Environmental chamber*, capable of maintaining temperatures of $60 \pm 2^\circ\text{F}$ ($16 \pm 1^\circ\text{C}$), $80 \pm 2^\circ\text{F}$ ($27 \pm 1^\circ\text{C}$), and $105 \pm 2^\circ\text{F}$ ($41 \pm 1^\circ\text{C}$) [Type I only].
- 10.2.1.3 *Thickness gauge*, with a resolution of at least 0.00005 in. (0.001 mm).
- 10.2.1.4 *Calipers*, with a resolution of at least 0.001 in. (0.03 mm).
- 10.2.1.5 *Metal plate*, smooth, clean, 3×6 in. (76×152 mm) approximately 0.1-in. (2.5-mm) thick. **For Type VIII, use a 3×6 -in. (76×152 -mm) concrete block.**
- 10.2.1.6 *Steel forms*, 3×6 in. (76×152 mm) with 2×4 -in. (51×102 -mm) cutout in the center of the following thicknesses: 0.1 in. (2.5 mm), 0.05 in. (1.3 mm), and 0.25 in. (6.4 mm).
- 10.2.1.7 *Metal spatula*.
- 10.2.1.8 *Metal ointment can*, 3 fl. oz. (85 mL).
- 10.2.1.9 *Balance*, Class G5 in accordance with Tex-901-K, minimum capacity of 2000 g.
- 10.2.2 *Procedure:*
- 10.2.2.1 Using the component ratios, determine the amount of each component necessary to produce 50 g of mixed epoxy. Measure each component into separate 3-fl. oz. (85-mL) metal ointment cans.
- 10.2.2.2 Obtain the 3×6 -in. (76×152 -mm) metal plate and the 3×6 -in. (76×152 -mm) metal form with a 2×4 -in. (51×102 -mm) cutout in the center. Use a form of the thickness specified. If measuring the amount of sag, scribe a mark across the metal plate 1 in. from the edge and parallel to the 3-in. (76-mm) side. The mark will correspond with one end of the 2×4 -in. (51×102 -mm) cutout in the steel form.
- 10.2.2.3 Condition the epoxy components, metal plate, steel form, and a spatula at the temperature specified in Table 2.
Note 13—For Type II epoxy, perform Sections 10.2.2.4–10.2.2.7 within 2 min.
- 10.2.2.4 Remove the epoxy components and a spatula from the oven or environmental chamber if necessary. Transfer the resin to the hardener can and mix with a spatula for 3 min.
Note 14—Mix heated epoxy for only 1 min.
- 10.2.2.5 Remove the steel plate and form from the oven or the environmental chamber if necessary. Place them on a horizontal surface with two to three sheets of paper or a piece of thin cardboard under the steel plate. Place the form on the plate, and align the sides of the plate and the form. If measuring the amount of sag, align the scribed mark with one side of the 2×4 -in. (51×102 -mm) cutout in the form. Make note of where the mark is.
- 10.2.2.6 Pour an excess of mixed adhesive immediately into the form. Use a spatula to screed adhesive on the top surface of the form, being careful not to allow the form to shift during the screeding process. Slowly lift the form upward.
Note 15—This will leave a 2×4 -in. (51×102 -mm) panel of epoxy on the plate.

- 10.2.2.7 Stand the steel plate vertically with the 6-in. (152-mm) sides of the plate vertical and the 3-in. (76-mm) sides on the top and bottom. If measuring the amount of sag, make sure the scribed end of the plate is at the bottom. Condition the plate at the temperature specified until the epoxy has hardened.
- 10.2.2.8 To determine the amount of sag, perform the following steps:
- 10.2.2.8.1 After the adhesive has hardened, remove the plate from the oven or environmental chamber if necessary. Measure the distance the epoxy sagged over the edge of scribed line.
- 10.2.2.8.2 Take three measurements: one at the center and one at each edge. Average the three measurements. Report the average to the nearest 0.01 in. (0.5 mm).
- 10.2.2.9 To measure the amount of thickness retained by the epoxy, perform the following steps.
- 10.2.2.9.1 Remove the plate with the epoxy panel from the oven. Allow the plate to cool to room temperature. Using the thickness gage, take eight measurements: four on each side of the epoxy layer. Before taking each thickness reading, zero the thickness gauge by measuring the thickness of steel plate next to the four readings on each side.
- 10.2.2.9.2 Start measuring the epoxy thickness at 0.5 in. (13 mm) from the top and sides, then read down 1 in. (25.4 mm) apart and 0.5 in. (13 mm) from side. Average all readings and report to the nearest 0.001 in. (0.05 mm).
- 10.3 *Thixotropy Test for Epoxy Type X:*
- 10.3.1 *Apparatus:*
- 10.3.1.1 *Balance*, Class G5 in accordance with Tex-901-K, minimum capacity of 2000 g.
- 10.3.1.2 *Thermometer*, range 66–80°F (19–27°C) (F17 thermometer as shown in ASTM E 1).
- 10.3.1.3 *Thickness gauge*, with a resolution of at least 0.00005 in. (0.001 mm).
- 10.3.1.4 *Steel plates*, smooth, 5 × 8 × 0.1 in. (127 × 203 × 2.5 mm).
- 10.3.1.5 *Adjustable film former*, such as a Boston Bradley drawdown gauge with a path at least 3-in. wide and the opening set at approximately 16 mils.
- 10.3.1.6 *Metal ointment can*, 6 fl. oz. (170 mL).
- 10.3.1.7 *Metal spatula*.

10.3.2 Procedure:

- 10.3.2.1 Determine the average thickness to the nearest 0.001 in. (0.03 mm) of a 2 × 4 in. (51 × 102 mm) area on a smooth, clean 5 × 8-in. (127 × 203-mm) steel plate. The 2 × 4-in. (51 × 102-mm) area is 3 in. (76 mm) from the top and 1 in. (25 mm) from the bottom along the 8-in. (203-mm) dimension, and 1.5 in. (38 mm) from each side along the 5-in. (127-mm) dimension of the plate. Using the thickness gage, take eight random readings, and record the average.
- 10.3.2.2 Ensure that the initial temperature of each epoxy component is $77 \pm 2^{\circ}\text{F}$ ($25 \pm 1^{\circ}\text{C}$). Using the component ratios, determine the amount of each component necessary to produce 100 g of mixed epoxy. Weigh out the components into a metal can. Stir the two components of the epoxy coating for 5 min.
- 10.3.2.3 Using approximately half of the mixed material, apply the epoxy on the plate in two lines of equal amounts: one at top and one at center of the steel plate. Draw a 16-mil film down the length of the steel plate using the film former.
- 10.3.2.4 After forming the epoxy film, stand the steel panel in a vertical position on its short edge. Make sure that no more than 10 min. elapse between the mixing time and the placing of the steel panel in the vertical position. Let stand overnight.
- 10.3.2.5 Measure the thickness retained by the epoxy. After the epoxy has hardened, measure the average thickness of coating covering the 2 × 4-in. (51 × 102-mm) area of the steel plate defined in Section 10.3.2.1. Take eight random readings.
- 10.3.2.6 Determine the average cured coating thickness by subtracting the average steel panel thickness from the average of total panel plus coating thickness.

11. ADHESIVE SHEAR STRENGTH

- 11.1 Use the following procedure to determine the adhesive shear strength of Type II epoxy.
- 11.2 *Apparatus:*
- 11.2.1 *Steel specimens*, 1 × 6.5 × 0.064 in. (25 × 165 × 1.6 mm).
- 11.2.2 *Sandblasting machine.*
- 11.2.3 *Garnet blasting abrasive*, 36 mesh.
- 11.2.4 *Testing machine*, as described in ASTM D 1002, Section 5.
- 11.3 *Procedure:*
- 11.3.1 Follow the procedure in accordance with ASTM D 1002.
- 11.3.2 Prepare the surfaces of the individual precut specimens by sandblasting to white metal.

- 11.3.3 Clean blasted ends with compressed air.
 - 11.3.4 Cure the test specimens for 7 days at 70 to 80°F (21 to 27°C) before testing.
-

12. IMPACT STRENGTH

- 12.1 Use the following method to determine the impact strength of epoxy Type II.
- 12.2 *Apparatus:*
 - 12.2.1 *Balance*, Class G5 in accordance with Tex-901-K, minimum capacity of 2000 g.
 - 12.2.2 *Disk molds*, to make a 2.5 ± 0.5 -in. (64 ± 1 -mm) diameter \times 0.37 ± 0.01 -in. (9.5 ± 0.3 -mm) thick disk.
 - 12.2.3 *Sanding lathe*.
 - 12.2.4 *Machined steel plate*, $6 \times 6 \times 0.5$ in. ($152 \times 152 \times 13$ mm).
 - 12.2.5 *Steel pipe*, 2-in. (51 mm) inside diameter, approximately 3 ft. (1 m) in length.
 - 12.2.6 *Steel ball*, 1 lb. (454 g).
 - 12.2.7 *Metal ointment can*, 6 fl. oz. (170 mL).
- 12.3 *Procedure:*
 - 12.3.1 Obtain at least three disk molds.
 - 12.3.2 Ensure that the initial temperature of each epoxy component is $77 \pm 2^\circ\text{F}$ ($25 \pm 1^\circ\text{C}$). Using the component ratios, determine the amount of each component necessary to produce 200 g of mixed epoxy. Weigh out the components into a metal can. Mix the epoxy for 3 min.
 - 12.3.3 Pour the epoxy into the molds. Carefully tap the molds on countertop to level material and remove bubbles. Cure the epoxy for 7 days at 70–80°F (21–27°C).
 - 12.3.4 Remove the epoxy specimens from the molds. Grind or machine the plane surfaces of the epoxy disks flat and parallel. The thickness of the finished specimen is 0.30 ± 0.02 in. (8 ± 0.5 mm). Smooth the specimens with No. 180 grit sandpaper. Blow the disks clean with oil-free compressed air.
Note 16—Be careful not to heat the specimen above 120°F (49°C) when machining or grinding.
 - 12.3.5 Place the finished specimens on a machined steel plate securely attached to a concrete slab. Place the 3-ft. (1-m) steel pipe above the machined steel plate such that the top of the pipe is 5 ft. (1.5 m) above the plate. Place the epoxy disk on the steel plate directly below the pipe. The pipe acts as a guide for the ball to fall on the epoxy disk.

- 12.3.6 Drop a 1-lb. (454-g) ball onto the center of the disks from an initial height of 5 ft. (1.5 m). Increase the height of the pipe by 6 in. (152 mm) for each successive drop until the specimen fails by cracking or shattering or until reaching a maximum height of 7 ft. (2.1 m). Record the height of the drop at which the failure occurs. Repeat for the rest of the specimens.

Note 17—Do not allow the ball to strike the disk after rebounding from the test drop.

- 12.3.7 Report the average to the nearest 0.5 ft. lb. (0.7 joule).

13. WET STRENGTH

- 13.1 Use the following method to determine the wet strength of epoxy Types II, IV, and IX.

13.2 *Apparatus:*

- 13.2.1 *Balance*, Class G5 in accordance with Tex-901-K, minimum capacity of 2000 g.

- 13.2.2 *Metal spatula.*

- 13.2.3 *Metal ointment can*, 6 fl. oz. (170 mL).

- 13.2.4 *Mortar briquettes.*

- 13.2.5 *Water bath*, capable of maintaining $100 \pm 2^\circ\text{F}$ ($38 \pm 1^\circ\text{C}$).

- 13.2.6 *Water bath*, capable of maintaining $73 \pm 2^\circ\text{F}$ ($23 \pm 1^\circ\text{C}$).

- 13.2.7 *Testing machine*, capable of maintaining a constant rate of travel of 0.05 in./min. (1.3 mm/min.) and applying a tensile force of at least 500 lbf. (2.2 kN) Use grips to hold specimens as shown in Figure 3.

13.3 *Procedure:*

- 13.3.1 Obtain three sets of mortar briquettes made in accordance with Section 8.2. Sandblast the bonding face of each mortar briquette. Clean the bonding faces of the briquettes with compressed air.

- For Type IX epoxy, soak the briquettes in distilled or deionized water at $77 \pm 2^\circ\text{F}$ ($25 \pm 1^\circ\text{C}$) for 24 hr., remove the briquettes from the water bath, and blow the bonding faces dry with oil-free compressed air.

Note 18—Do not touch bonding faces after sandblasting.

- 13.3.2 Ensure that the initial temperature of each epoxy component is $77 \pm 2^\circ\text{F}$ ($25 \pm 1^\circ\text{C}$). Using the component ratios, determine the amount of each component necessary to make a total 50 g of mixed epoxy. Weigh 50 g of epoxy components in a metal can. Mix with a spatula for 3 min.

- 13.3.3 Place a small amount of epoxy on the bonding face of each briquette. Use a spatula to spread the epoxy uniformly across the bonding face. Place the faces of two briquette

halves together with light pressure, and repeat for the remaining briquettes. Remove the excess epoxy from the edges of the bonded area with a spatula and stand upright.

Note 19—For Type II epoxy, allow no more than 6 min. to elapse during preparation of the specimens.

- 13.3.4 Allow the briquettes to cure for 24 hr. at $77 \pm 2^\circ\text{F}$ ($25 \pm 1^\circ\text{C}$). Immediately transfer the briquettes to an oven at $120 \pm 2^\circ\text{F}$ ($49 \pm 1^\circ\text{C}$) for 48 hr. Immerse the cured specimens in a distilled or deionized water bath maintained at $100 \pm 2^\circ\text{F}$ ($38 \pm 1^\circ\text{C}$) for 4 days. Remove specimens and place them in a distilled or deionized water bath at $73 \pm 2^\circ\text{F}$ ($23 \pm 1^\circ\text{C}$) for 1 hr.
- 13.3.5 Start up tensile machine according to manufacturer's instructions. Balance and calibrate the tensile machine. Place the grips on the machine. Set the crosshead speed to 0.05 in./min. (1.3 mm/min.)
- 13.3.6 Load a briquette into the tensile machine. Start the testing machine and load until break. Record the load at break. Repeat the test on a second specimen.
- 13.3.7 Report the average load at break as the wet bond strength.
- 13.3.8 Test the third specimen if either of the tested briquettes fails in the mortar at strengths below 270 psi (1862 kPa).

14. WET PULLOUT STRENGTH

- 14.1 Use the following method to determine the wet pullout strength of epoxy Type III.
- 14.2 *Apparatus:*
- 14.2.1 *Balance*, Class G5 in accordance with Tex-901-K, minimum capacity of 2000 g.
- 14.2.2 *Rebar*, grade 60, #3, 30 in. (760 mm) in length.
- 14.2.3 *Concrete block*, with a minimum size of $6 \times 6 \times 8$ in. ($150 \times 150 \times 200$ mm) or a concrete cylinder with a minimum size of 6 in. (150 mm) diameter and 8 in. (200 mm) high. The block or cylinder must be compression rated at $5,000 \pm 500$ lb. (22.3 ± 2.2 kN).
- 14.2.4 *Water bath*, capable of maintaining $77 \pm 3^\circ\text{F}$ ($25 \pm 2^\circ\text{C}$).
- 14.2.5 *Carbide tip masonry drill bit*, $6 \times 5/8$ in. diameter (150×13 mm).
- 14.2.6 *Hammer drill*.
- 14.2.7 *Metal ointment can*, 6 fl. oz. (170 mL).
- 14.2.8 *Testing machine* capable of maintaining a constant rate of travel of 0.2 in./min. (5 mm/min.) and applying a tensile force of at least 10,000 lbf. (44.5 kN).

- 14.2.9 *Mechanical wedge grips*, with v-shaped jaw faces, to grab the rebar end of the pullout specimen.
- 14.2.10 *Fixture*, shown in Figure 4, to hold the concrete block end of the pullout specimen. This apparatus consists of the following: one steel plate, four steel rods with threading on both ends, and four bolts. The plate must be $10.75 \times 8.75 \times 0.5$ in. ($273 \times 222 \times 13$ mm) and must have five holes: one 0.8-in. (20-mm) diameter hole in each corner, and one 1.75-in. (44-mm) diameter hole in the center. The four steel rods must be 13.75 in. (350 mm) long and 0.77 in. (20 mm) in diameter with 2.25 in. (57 mm) of threading on each end. The threading must be able to fasten into the bottom plate of the testing machine on one end and fasten into the bolts on the other end. Alter the dimensions to accommodate other testing machines.

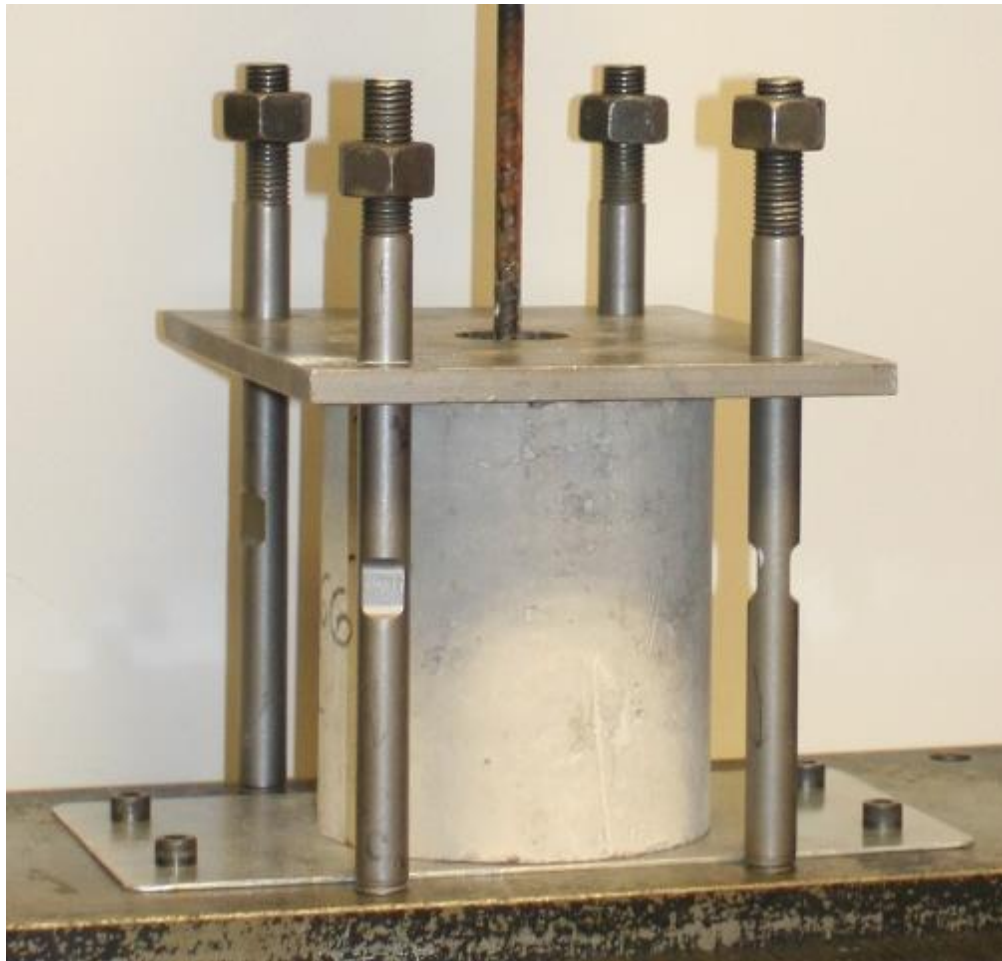


Figure 4—Fixture for Holding a Concrete Block During a Wet Pullout Test

- 14.3 *Procedure:*
- 14.3.1 Drill a hole, 5/8 in. (13 mm) in diameter and 3.5 in. (90 mm) in depth, at the center of the top surface of the concrete block or cylinder. Remove debris and dust from the hole using moisture-free compressed air. Ensure the rebar fits without binding.

- 14.3.2 Ensure that the initial temperature of each epoxy component is $77 \pm 2^\circ\text{F}$ ($25 \pm 1^\circ\text{C}$). Using the component ratios, determine the amount of each component necessary to make a total 50 g of mixed epoxy. Weigh 50 g of epoxy components into a metal can. Mix with a spatula for 3 min.
- 14.3.3 Place the epoxy in the hole in the specimen. Insert the rebar the entire depth of the hole, rotating the rebar several times to ensure that the epoxy adequately coats the rebar and to remove air pockets in the epoxy. Repeat filling the hole and inserting the rebar as necessary until the hole is full. Remove excess epoxy from the surface of the cylinder.
Note 20—To ensure a valid test, the rebar must remain plumb and centrally located in the hole.
- 14.3.4 Cure the specimen in air for 24 hr. at $77 \pm 3^\circ\text{F}$ ($25 \pm 2^\circ\text{C}$). Submerge the block into a water bath at $77 \pm 3^\circ\text{F}$ ($25 \pm 2^\circ\text{C}$) in an upright position for 6 days.
- 14.3.5 Start up, balance, and calibrate the tensile machine according to manufacturer's instructions. Place a wedge grip on the testing machine as the top fixture. Screw the four rods into the bottom plate of the testing machine. Set the crosshead speed to 0.2 in./min. (5 mm/min.)
- 14.3.6 Place the specimen in between the rods on the testing machine. Place the steel plate over the block. Fit the rebar through the center hole and the four rods through the four holes at the corners of the plate. Grip the rebar in the wedge grip. Lift the block 2 in. and adjust the block to ensure the rebar is pulling straight. With the block lifted, tighten the four nuts to the steel plate.
- 14.3.7 Start the testing machine and load until break. Record the load at break.
- 14.3.8 Report the load at break as the wet pullout strength.
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15. GRIND

- 15.1 Use the following method to determine the grind of epoxy Type X.
- 15.2 *Apparatus:*
- 15.2.1 *Balance*, Class G5 in accordance with Tex-901-K, minimum capacity of 2000 g.
- 15.2.2 *Metal spatula.*
- 15.2.3 *Metal ointment can*, 3 fl. oz. (85 mL).
- 15.2.4 *Tapered gauge*, a hardened steel, stainless steel, or chrome-plated steel block approximately 7.5 in. (190 mm) in length, 3.5 in. (90 mm) in width, and 1 in. (25 mm) in thickness. The top surface of the block is ground smooth and planar and contains a 5-in. (127-mm) long by 2-in. (50-mm) wide path. The path is tapered uniformly in depth lengthwise from about 4 mils (100 μm) at 0.4 in. (10 mm) from one end to zero depth at the other, with intermediate calibrations in accordance with the depth at those points. The preferred calibration is Hegman units.
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- 15.2.5 *Scraper*, a double-edged hardened steel, stainless steel, or chrome-plated steel blade 3.75-in. (95-mm) long, 1.5-in. (40-mm) wide, and 0.25-in. (6.4-mm) thick. The two edges on the 3.75-in. sides are rounded to a radius of 0.015 in. (0.38 mm).
- 15.3 *Procedure:*
- 15.3.1 Weigh 10 g of the resin component into a metal can. Add 2 g of xylene. Stir until it is a homogenous mixture.
- 15.3.2 Perform the grind test on the epoxy resin in accordance with ASTM D 1210.
- 15.3.3 Record the results.
- Note 21**—Refer to ASTM D 1210 for guidance on interpretation of test results.
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16. BOND STRENGTH OF FRESH CONCRETE TO CURED CONCRETE

- 16.1 Use the following method to determine the old to new concrete bond strength for epoxy Types V and VII.
- 16.2 *Apparatus:*
- 16.2.1 *Balance*, Class G5 in accordance with Tex-901-K, minimum capacity of 2000 g.
- 16.2.2 *Metal spatula*.
- 16.2.3 *Metal ointment can*, 3 fl. oz. (85 mL).
- 16.2.4 *Mortar briquettes*.
- 16.2.5 *Sand and cement*, to prepare mortar as described in Section 8.2 of this method.
- 16.2.6 *Briquette molds*, as described in Section 8.2.1.3 of this method.
- 16.2.7 *Testing machine*, capable of maintaining a constant rate of travel of 0.05 in./min. (1.3 mm/min.) and applying a tensile force of at least 500 lbf. (2.2 kN) Use grips to hold specimens as shown in Figure 3.
- 16.3 *Procedure:*
- 16.3.1 Obtain briquettes made in accordance with Section 8.2 of this method. Sandblast the bonding face of each mortar briquette. Clean the bonding faces of the briquettes with compressed air.
- Note 22**—Do not touch bonding faces after sandblasting.
- 16.3.2 Ensure that the initial temperature of each epoxy component is $77 \pm 2^{\circ}\text{F}$ ($25 \pm 1^{\circ}\text{C}$). Using the component ratios, determine the amount of each component necessary to make a total 50 g of mixed epoxy. Weigh 50 g of epoxy components into a metal ointment can. Mix with a spatula for 3 min.
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- 16.3.3 Take one of the briquettes and place a small amount of epoxy on the bonding face. Use a spatula to spread the epoxy uniformly across the surface. Repeat for the remaining briquettes.
- 16.3.4 Prepare new mortar as described in Section 8.2 of this method. Place each briquette into a briquette mold. Mold the new mortar against each of the three briquettes to form three complete tensile specimens. Cure the specimens for 7 days in accordance with Section 8.2.
- 16.3.5 Start up, balance, and calibrate the tensile machine according to manufacturer's instructions. Place the grips on the machine. Set the crosshead speed to 0.05 in./min. (1.3 mm/min.)
- 16.3.6 Load a specimen into the tensile machine. Start the testing machine and load until break. Record the load at break. Repeat the test on a second specimen.
- 16.3.7 Report the average load at break as the bond strength. Test the third specimen if either of the tested specimens fails in the mortar at strengths below 270 psi (1862 kPa).
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17. OLD CONCRETE TO NEW GROUT MIX

- 17.1 Use the following method to determine the old concrete to new grout mix bond strength for epoxy Type VIII.
- 17.2 *Apparatus:*
- 17.2.1 *Balance*, Class G5 in accordance with Tex-901-K, minimum capacity of 2000 g.
- 17.2.2 *Metal spatula.*
- 17.2.3 *Friction top can*, 1 pt. (500 mL), with friction lip removed.
- 17.2.4 *Mortar briquettes.*
- 17.2.5 *Briquette molds*, as described in Section 8.2.1.3 of this method.
- 17.2.6 *Testing machine*, capable of maintaining a constant rate of travel of 0.05 in./min. (1.3 mm/min.) and applying a tensile force of at least 500 lbf. (2.2 kN) Use grips to hold specimens as shown in Figure 3.
- 17.3 *Procedure:*
- 17.3.1 Obtain briquettes made in accordance with Section 8.2 of this method. Sandblast the bonding face of each mortar briquette. Clean the bonding faces of the briquettes with compressed air.
- Note 23**—Do not touch bonding faces after sandblasting.
- 17.3.2 Ensure that the initial temperature of each epoxy component is $77 \pm 2^{\circ}\text{F}$ ($25 \pm 1^{\circ}\text{C}$). Using the component ratios, determine the amount of each component necessary to make

a total 250 g of mixed grout. Weigh the grout components in a 1-pt. (500-mL) can. Mix with a spatula for 3 min.

- 17.3.3 Place each briquette into a briquette mold. Mold the epoxy grout against each of the three briquettes to form three complete tensile specimens. Cure the specimens for 7 days at $77 \pm 2^\circ\text{F}$ ($25 \pm 1^\circ\text{C}$).
 - 17.3.4 Start up, balance, and calibrate the tensile machine according to manufacturer's instructions. Place the grips on the machine. Set the crosshead speed to 0.05 in./min. (1.3 mm/min.).
 - 17.3.5 Load a specimen into the tensile machine. Start the testing machine and load until break. Record the load at break. Repeat the test on a second specimen.
 - 17.3.6 Report the average load at break as the bond strength. Test the third specimen if either of the tested specimens fails in the cement mortar at strengths below 270 psi (1862 kPa).
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18. HIDING POWER

- 18.1 Use the following method to determine the hiding power of epoxy Type X only.
- 18.2 *Apparatus:*
 - 18.2.1 *Balance*, Class G5 in accordance with Tex-901-K, minimum capacity of 2000 g.
 - 18.2.2 *Black and white paper charts*, smooth, level, and impervious to paint liquids. The black area must have a maximum reflectance of 1% and the white area a minimum reflectance of 78%. The white area must be non-fluorescent.
 - 18.2.3 *Draw down gauge*, 5 mil.
 - 18.2.4 *Vacuum platter*, or other suitable device.
 - 18.2.5 *Reflectance measurement instrument*, that allows diffusely reflected, radiant flux to be incident upon the measuring element. It must employ a photometric system, including source, filters, and receptor, that provides a response closely similar to the product of the spectral luminous efficiency function of the CIE standard observer and source C. It must provide readings to at least the third decimal place and permit estimation to the fourth.
 - 18.2.6 *Metal ointment can*, 6 fl. oz. (170 mL).
- 18.3 *Procedure:*
 - 18.3.1 Ensure that the initial temperature of each epoxy component is $77 \pm 2^\circ\text{F}$ ($25 \pm 1^\circ\text{C}$). Using the component ratios, determine the amount of each component necessary to make a total 50 g of mixed epoxy. Weigh the components into a metal can. Mix with a spatula for 5 min.
 - 18.3.2 Place the black and white paper chart on a flat surface. Pour two horizontal lines of mixed epoxy on the black and white paper, one on each color. Make the lines the width

of the draw down gauge. Put the draw down gauge at the top of the paper, and draw it down at approximately 2.4 in./sec. (61 mm/sec.)

18.3.3 Place the black and white paper chart in a well-ventilated dust free location and allow to dry overnight.

18.3.4 Measure the reflectance at three random points on each color. Calculate the contrast ratio by dividing the reflectance on white substrate (Y_w) into the reflectance on black substrate (Y_b).

19. WATER GAIN

19.1 Use the following method to determine the water gain of epoxy Type VIII.

19.2 *Apparatus:*

19.2.1 *Disk molds*, to make a 2.5 ± 0.5 -in. (64 ± 1 -mm) diameter by 0.37 ± 0.01 -in. (9.5 ± 0.3 -mm) thick disk.

19.2.2 *Distilled or deionized water.*

19.2.3 *Glass container*, approximately 6–10 in. (152–154 mm) deep and 4–5 in. (102–127 mm) in diameter.

19.2.4 *Silicon carbide sandpaper*, No. 180 grit.

19.2.5 *Machine lathe.*

19.2.6 *Analytical balance*, Class B in accordance with Tex-901-K, minimum capacity of 100 g.

19.3 *Procedure:*

19.3.1 Obtain three disk molds.

19.3.2 Ensure that the initial temperature of each epoxy component is $77 \pm 2^\circ\text{F}$ ($25 \pm 1^\circ\text{C}$). Using the component ratios, determine the amount of each component necessary to produce 200 g of mixed epoxy. Weigh out the components into a metal can. Mix the epoxy for 3 min.

19.3.3 Pour the epoxy into the disk molds. Carefully tap disks on countertop to level material and remove bubbles. Cure the disks for 7 days at 70 to 80°F (21 to 27°C).

19.3.4 Remove the epoxy disks from the molds. Grind or machine the plane surfaces of the disks flat and parallel. The thickness of the finished disks must be 0.30 ± 0.02 in. (8 ± 0.5 mm). Smooth the specimens with No. 180 grit sandpaper. Blow the disks clean with oil-free compressed air.

Note 24—Be careful not to heat the disks above 120°F (49°C) when machining or grinding.

- 19.3.5 Weigh the disks on an analytical balance to the nearest 0.001g.
- 19.3.6 Fill a water bath with distilled or deionized water maintained at $77 \pm 4^{\circ}\text{F}$ ($25 \pm 2^{\circ}\text{C}$). Immerse the disks in the water bath for 24 hr.
- 19.3.7 Remove one of the disks from the water bath. Wipe the surface water off with a dry cloth. Immediately weigh the disk to the nearest 0.001 g. Repeat for the other two disks.
- 19.3.8 Calculate the percent increase in weight of each disk. Average the results and report to the nearest 0.1%.

19.4 *Calculations:*

- 19.4.1 Calculate increase in weight:

$$\text{Increase in weight, \%} = \frac{\text{wet weight} - \text{conditioned weight}}{\text{conditioned weight}} \times 100$$

Where:

Increase in weight, % = percent increase in the weight of the sample

wet weight = weight of the sample after soaking in water, g

conditioned weight = weight of the conditioned sample before soaking in water, g.

20. CONTACT TIME

- 20.1 Use the following method to determine the contact time for Type I epoxy only.
- 20.2 *Apparatus:*
- 20.2.1 *Balance*, Class G5 in accordance with Tex-901-K, minimum capacity of 2000 g.
- 20.2.2 *Metal spatula*.
- 20.2.3 *Metal ointment can*, 6 fl. oz. (170 mL).
- 20.2.4 *Mortar briquettes*.
- 20.3 *Procedure:*
- 20.3.1 Obtain briquettes made in accordance with Section 8.2 of this method. Sandblast the bonding face of each mortar briquette. Clean the bonding faces of the briquettes with compressed air.
- Note 25**—Do not touch bonding faces after sandblasting.
- 20.3.2 Condition epoxy components to the temperature specified in Table 3. Using the component ratios, determine the amount of each component necessary to make a total 50 g of mixed epoxy. Weigh 50 g of epoxy components in a metal can. Mix with a spatula for 3 min.

Table 3 -- Contact Time Temperatures

Type I Epoxy Class	Temperature
A	60°F (16°C)
B	80°F (27°C)
C	105°F (41°C)

- 20.3.3 Place a small amount of epoxy on the bonding face of one briquette. Use a spatula to spread the epoxy uniformly across the surface. Repeat for remaining briquettes. Let the briquette halves sit for 60 min. at the temperature specified in Table 3.
- 20.3.4 After 60 min., put two briquette halves together. If the briquettes adhere together, the epoxy meets the 60-min. contact time requirement. If the epoxy has hardened and the briquettes do not stick together, the epoxy does not meet the 60-min. contact time requirement.
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21. ARCHIVED VERSIONS

- 21.1 Archived versions are available.